

Ultrafast Quantum Control

Philip H. Bucksbaum
Otto Laporte Professor of Physics
FOCUS Center, Physics Department, University of Michigan

Quantum control employs amplified and programmably shaped ultrafast coherent radiation pulses to control dynamics in matter. The objective is a new quantum state of the physical system, such as a new chemical, a special kind of light, or an excited state of a molecule with special properties. Perhaps the most exciting development in quantum control research is the learning control algorithm. In a learning algorithm, the quantum system under study actually runs the experiment itself! The apparatus interrogates the atom or molecule, which provides direct feedback to the laser. The laser system and the quantum system work together through an evolutionary trial-and-error approach to find the optical field that can produce the desired dynamics. This is a new way to investigate the properties of many-body quantum systems, and has promise for new chemicals, new methods for quantum computing, or more efficient ways to produce and control x-rays. This talk will explore learning control algorithms, and how they can yield information about the forces controlling quantum dynamics in molecules.